Bingham Docket No. 7240166001-3002431
Honeywell Docket No. H0005045 PCT -4018

IN THE EUROPEAN INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY (IPEA/EPO)

PCT/US2004/017906	04/06/2004	06/06/2003
International Application Number	International Filing Date	International Earliest Priority Date

Title of Invention: **THERMAL INTERCONNECT SYSTEMS, METHODS OF PRODUCTION AND USES THEREOF**

Applicant: **HONEYWELL INTERNATIONAL INC.**

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RESPONSE TO WRITTEN OPINION

1. Applicant herewith submits replacement sheets(s) number(ed) **17-19** to replace sheet(s) number(ed) **17-19**, originally filed for this application.

2. In respect of each claim appearing in the international application based on the replacement sheets submitted herewith, the following claim(s) is/are:

(i)	unchanged:	claim(s) **1-14, 18-32 and 36**
(ii)	cancelled:	claim(s) **0**
(iii)	new:	claim(s) **0**
(iv)	replacement of one or more claims as filed, as follows: **15-17 and 33-35**	
(v)	the result of the division of one or more claims as filed, as follows: **0**	

Dear Sir:

In response to the Notification of Transmittal of the International Search Report and the Written Opinion of the International Searching Authority dated December 16, 2004, please replace original pages **17-19** with substitute pages **17-19**.

IN THE CLAIMS

1. (Original) A thermal transfer material, comprising:

a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material, and

at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component.

2. (Original) The thermal transfer material of claim 1, wherein the solder material is further coupled to a substrate.

3. (Original) The thermal transfer material of claim 2, wherein the substrate comprises silicon.

4. (Original) The thermal transfer material of claim 3, wherein the substrate is a metalized silicon die.

5. (Original) The thermal transfer material of claim 1, wherein the heat spreader component comprises a metal, metal-based material or combination thereof.

6. (Original) The thermal transfer material of claim 5, wherein the heat spreader component comprises nickel, aluminum, copper or a combination thereof.

7. (Original) The thermal transfer material of claim 5, wherein the metal-based material comprises silicon, carbon or a combination thereof.

8. (Original) The thermal transfer material of claim 1, wherein the heat spreader component comprises a thickness of about 0.25 mm to about 6 mm.

9. (Original) The thermal transfer material of claim 8, wherein the thickness is from about 1 mm to about 5 mm.

10. (Original) The thermal transfer material of claim 1, wherein the at least one solder material comprises a metal, a metal-based material or a combination thereof.

11. (Original) The thermal transfer material of claim 10, wherein the metal comprises a transition metal.

12. (Original) The thermal transfer material of claim 11, wherein the metal comprises indium, tin, lead, silver, copper, antimony, tellurium or bismuth.

13. (Original) The thermal transfer material of claim 11, wherein the metal-based material comprises an alloy.

14. (Original) The thermal transfer material of claim 13, wherein the alloy comprises indium, tin, lead, silver, copper, antimony, tellurium, bismuth or a combination thereof.

15. (Currently Amended) The thermal transfer material of one of claims 12 or 13, further comprising a layer of a noble metal or a ~~low temperature~~ silicide former.

16. (Currently Amended) The thermal transfer material of claim 15, wherein the ~~low temperature~~ silicide former comprises silver, platinum or palladium.

17. (Currently Amended) The thermal transfer material of claim 16, wherein the ~~low temperature~~ silicide former ~~produces~~ is a flash layer.

18. (Original) The thermal transfer material of claim 1, wherein the solder material is directly deposited using electrodeposition.

19. (Original) A method of forming a thermal transfer material, comprising:

providing a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material;

providing at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component; and

depositing the at least one solder material onto the bottom surface of the heat spreader component.

20. (Original) The method of claim 19, wherein the solder material is further coupled to a substrate.

21. (Original) The method of claim 20, wherein the substrate comprises silicon.

22. (Original) The method of claim 21, wherein the substrate is a metalized silicon die.

23. (Original) The method of claim 19, wherein the heat spreader component comprises a metal, metal-based material or combination thereof.

24. (Original) The method of claim 23, wherein the heat spreader component comprises nickel, aluminum, copper or a combination thereof.

25. (Original) The method of claim 23, wherein the metal-based material comprises silicon, carbon or a combination thereof.

26. (Original) The method of claim 19, wherein the heat spreader component comprises a thickness of about 0.25 mm to about 6 mm.

27. (Original) The method of claim 26, wherein the thickness is from about 1 mm to about 5 mm.

28. (Original) The method of claim 19, wherein the at least one solder material comprises a metal, a metal-based material or a combination thereof.

29. (Original) The method of claim 28, wherein the metal comprises a transition metal.

30. (Original) The method of claim 29, wherein the metal comprises indium, tin, lead, silver, copper, antimony, tellurium or bismuth.

31. (Original) The method of claim 29, wherein the metal-based material comprises an alloy.

32. (Original) The method of claim 31, wherein the alloy comprises indium, tin, lead, silver, copper, antimony, tellurium, bismuth or a combination thereof.

33. (Currently Amended) The method of one of claims 30 or 31, further comprising a layer of a noble metal or a ~~low-temperature~~ silicide former.

34. (Currently Amended) The method of claim 33, wherein the ~~low-temperature~~ silicide former comprises silver, platinum or palladium.

35. (Currently Amended) The method of claim 34, wherein the ~~low-temperature~~ silicide former produces a flash layer.

36. (Original) The method of claim 19, wherein the solder material is directly deposited using electrodeposition.

REMARKS

CLAIM OBJECTIONS

Claims 15-17 and 33-35 are herein amended to remove the phrase "low temperature".

The Applicant disagrees with the Examiner regarding the phrase "flash layer". It is defined in the specification on page 10 and one of ordinary skill in the art should understand this phrase after reading that section of the specification.

Claim 17 is amended herein to replace the term "produces" with the term "is".

The Applicant is unclear as to what the Examiner is referring to with respect to claim 33. Claim 33 does refer to a method claim. The Applicant asks for additional guidance from the Examiner or for the Examiner to remove this objection.

CITED ART REJECTIONS

Claims 1-36 were deemed to be either anticipated by US 6,504,242 (Deppisch et al) or to not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step. The Applicant respectfully disagrees.

Claim 1 of the present application recites: "A thermal transfer material, comprising: a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material, and at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component."

Claim 19 of the present application recites: "A method of forming a thermal transfer material, comprising: providing a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material; providing at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component; and depositing the at least one solder material onto the bottom surface of the heat spreader component."

The specification of the present application states in the Background of the Invention section that: "As more solder materials are being utilized in components to dissipate heat, it has been discovered that it is difficult to solder to nickel without the use of a material, such as a flux, because of the production of detrimental nickel oxides at the solder-nickel interface. One recent approach to completing the solder joint without the use of a flux is to electrodeposit a gold spot on the precise location where the solder joint is to be formed. This approach is described in US Patent 6,504,242 issued to Deppisch et al. (January 7, 2003). **While this approach works well functionally, the value of gold contained within the spot is detrimental to the cost efficiency of the components. Furthermore, in order to complete a joint having a gold spot or gold interface, there are at least two process steps necessary – deposition of the gold and application of the solder material. These additional process steps are not only costly, but slow.**" (emphasis added)

In the Deppisch reference, the solder material is not directly deposited on the bottom surface of the heat spreader component. The technology described in the Deppisch reference requires the formation of a "gold spot" adhesive layer. Therefore, the claims of the present application are not anticipated by Deppisch. In addition, the claims of the present application do contain features which meet the requirements of novelty and/or inventive step in view of the Deppisch reference.

Claims 1-36 were deemed to be either anticipated by US 5,981,085 (Ninomiya et al) or to not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step. The Applicant respectfully disagrees.

Claim 1 of the present application recites: "A thermal transfer material, comprising: a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material, and at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component."

Claim 19 of the present application recites: "A method of forming a thermal transfer material, comprising: providing a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material; providing at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component; and depositing the at least one solder material onto the bottom surface of the heat spreader component."

The specification of the present application states in the Background of the Invention section that: "As more solder materials are being utilized in components to dissipate heat, it has been discovered that it is difficult to solder to nickel without the use of a material, such as a flux, because of the production of detrimental nickel oxides at the solder-nickel interface. One recent approach to completing the solder joint without the use of a flux is to electrodeposit a gold spot on the precise location where the solder joint is to be formed. This approach is described in US Patent 6,504,242 issued to Deppisch et al.

(January 7, 2003). While this approach works well functionally, the value of gold contained within the spot is detrimental to the cost efficiency of the components. Furthermore, in order to complete a joint having a gold spot or gold interface, there are at least two process steps necessary – deposition of the gold and application of the solder material. These additional process steps are not only costly, but slow."

In the Ninomiya reference, the solder material is not directly deposited on the bottom surface of the heat spreader component. Therefore, the claims of the present application are not anticipated by Deppisch. In addition, the claims of the present application do contain features which meet the requirements of novelty and/or inventive step in view of the Deppisch reference.

Claim 1-38 are deemed obvious in view of US 2003/047814 (Kwon). The Applicant respectfully disagrees, especially since Kwon does not teach, disclose or motivate one of ordinary skill in the art to directly deposit the solder material onto the bottom surface of the heat spreader material.

Claim 1 of the present application recites: "A thermal transfer material, comprising: a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material, and at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component."

Claim 19 of the present application recites: "A method of forming a thermal transfer material, comprising: providing a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material; providing at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component; and depositing the at least one solder material onto the bottom surface of the heat spreader component."

The specification of the present application states in the Background of the Invention section that: "As more solder materials are being utilized in components to

dissipate heat, it has been discovered that it is difficult to solder to nickel without the use of a material, such as a flux, because of the production of detrimental nickel oxides at the solder-nickel interface. One recent approach to completing the solder joint without the use of a flux is to electrodeposit a gold spot on the precise location where the solder joint is to be formed. This approach is described in US Patent 6,504,242 issued to Deppisch et al. (January 7, 2003). While this approach works well functionally, the value of gold contained within the spot is detrimental to the cost efficiency of the components. Furthermore, in order to complete a joint having a gold spot or gold interface, there are at least two process steps necessary – deposition of the gold and application of the solder material. These additional process steps are not only costly, but slow."

In the Kwon reference, a flux and a "flux filler" are used along with the solder materials and the substrate. Therefore, the claims of the present application are not obvious in view of Kwon. The Examiner must take into account the fact that the dependent claims cited by the Examiner contain the provisions of the related independent claims - claims 1 and 19. Neither of these claims are obvious in view of the Kwon reference, and therefore, the dependent claims the Examiner cites are also not obvious in view of Kwon.

Claim 1-38 are deemed obvious in view of US 2,439,935 (Jones). The Applicant respectfully disagrees, especially since Jones does not teach, disclose or motivate one of ordinary skill in the art to directly deposit the solder material onto the bottom surface of the heat spreader material.

Claim 1 of the present application recites: "A thermal transfer material, comprising: a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material, and at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component."

Claim 19 of the present application recites: "A method of forming a thermal transfer material, comprising: providing a heat spreader component, wherein the heat spreader component comprises a top surface, a bottom surface and at least one heat spreader material; providing at least one solder material, wherein the solder material is directly deposited onto the bottom surface of the heat spreader component; and depositing the at least one solder material onto the bottom surface of the heat spreader component."

The specification of the present application states in the Background of the Invention section that: "As more solder materials are being utilized in components to dissipate heat, it has been discovered that it is difficult to solder to nickel without the use of a material, such as a flux, because of the production of detrimental nickel oxides at the solder-nickel interface. One recent approach to completing the solder joint without the use of a flux is to electrodeposit a gold spot on the precise location where the solder joint is to be formed. This approach is described in US Patent 6,504,242 issued to Deppisch et al. (January 7, 2003). While this approach works well functionally, the value of gold contained within the spot is detrimental to the cost efficiency of the components. Furthermore, in order to complete a joint having a gold spot or gold interface, there are at least two process steps necessary – deposition of the gold and application of the solder material. These additional process steps are not only costly, but slow."

In the Jones reference, indium electroplating is described; however there is no suggestion, motivation or teaching to one of ordinary skill in the art that this material can

be electroplated onto a heat spreader component directly. Therefore, the claims of the present application are not obvious in view of Jones. The Examiner must take into account the fact that the dependent claims cited by the Examiner contain the provisions of the related independent claims - claims 1 and 19. Neither of these claims are obvious in view of the Jones reference, and therefore, the dependent claims the Examiner cites are also not obvious in view of Jones.

Respectfully submitted,

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Dated: March 15, 2005

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